Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/342
USSR
February 1964
Original: RUSSIAN

Confidential until official release during Conference

Abstract

EFFECT OF SOME FACTORS ON HYDROGENIZATION AND PROPERTIES OF ZIRCONIUM ALLOYS USED FOR JACKETS OF HEAT-PRODUCING ELEMENTS IN WATER-COOLED POWER REACTORS

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The report contains data on the studies carried out with the zirconium jackets of heat-producing elements and various zirconium-alloy specimen tested in experimental water loops of a physical and chemical research reactor. It was established that the degree of hydrogenization and the disposal of hydrides depend on the conditions under which the heat-producing elements operate. It was shown that the nature of disposal of hydrides in the jackets of the heat-producing elements varies with the increase of heat loads. At low heat loads hydrides are orientated along the generatrix, while at high heat loads they are disposed in the main radially. In addition, migration of hydrides towards the cooler side of the jacket was observed.

Effect of stresses on the nature of the disposal of hydrides which are formed due to corrosion in water was studied with the non-radioactive tubular specimen. It was found that with the greater stresses the number of radially disposed hydrides increases and that such a disposal of hydrides results in a sharp reduction of the mechanical strength of the jacket material.

In a physical and chemical research reactor an experi-

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mental assembly of heat-reducing elements with pre-hydrogenized zirconium-alloy jacket was tested. The assembly operated successfully at a heat load of 1.10^6 Cal/m^2 · hr. The results of detailed study of the jackets of the heat-producing elements of this assembly are presented.

The results are also described of the study of the mechanical properties and of the nature of disposal of hydrides in zirconium-alloy specimen pre-hydrogenized to a different degree and exposed to radiation together with this assembly of heat-producing elements. Specimen of the same series exposed to radiation in a "dry" channel were taken as reference ones. It was found that in the specimen exposed to radiation in a non-strained state in water to a temperature of 290°C and known to have a uniform distribution of hydrides, the change of mechanical properties at a flux of 10^{12} n/cm^2 accounted in the main for the radiation. It was proved furthermore that a greater succeptability of the specimen to notching results from pre-hydrogenization. Radiation results in a higher sensitivity of alloys to notching.

Investigations which have been carried out showed that despite some reduction in mechanical properties heat-producing elements with zirconium-niobium alloy jackets can be advantageously used in water-modulated water-cooled reactors.